REMARKS

This amendment is responsive to the Office Action mailed March 7, 2006. Reconsideration and allowance of claims 2-5, 7-11, 17, 18, 20-22, 24, 27, and 28 as set forth herein is earnestly requested.

The Status of the Claims

Claims 1-5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Fuller et al., U.S. Patent No. 5,792,668 (hereinafter "Fuller") in view of Kadin, U.S. Patent No. 4,653,068 (hereinafter "Kadin").

Claims 1 and 10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Eggleton et al., U.S. Patent No. 4,035,839 (hereinafter "Eggleton") in view of Kadin.

Claims 17, 18, 20, 25, and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Fuller in view of Abraham, U.S. Patent No. 6,407,987 (hereinafter "Abraham").

Claim 11 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Eggleton in view of Kadin in further view of Feldman et al., U.S. Patent No. 5,265,613 (hereinafter "Feldman").

The Present Application

In medical diagnostics, a source signal, which is typically narrowband or d.c., is injected into the patient or other subject via a medium interface. For example, an ECG applies a source electrical signal to a patient via electrodes, or an ultrasound machine applies an ultrasonic signal to the patient through an ultrasonic transducer, or so forth. The source signal interacts with the patient to produce a parameter that is measured to provide diagnostic information. Examples include an impedance measured respective to the ECG electrodes, or an ultrasound reflection, or so forth.

In a hospital or other medical setting, there are numerous extraneous sources of interference such as other diagnostic equipment, interventional equipment such as respirators, communication equipment such as cellular telephones, computers and digital networking systems, walkie-talkies or other hand-held radios, and so forth. If

any of these extraneous sources interfere with the source signal or the produced parameter then the medical diagnostic may produce an erroneous result.

The present application discloses adaptation of the known technique of spread spectrum communication to the field of diagnostic medical measurement. The inventors have recognized that using a spread spectrum signal and corresponding detection hardware for medical diagnostics advantageously reduces the likelihood that the instrument will be interfered with by other equipment, and advantageously reduces the likelihood that the medical instrument will interfere with other equipment.

Spread spectrum communication is defined in a typical scientific dictionary as a:

> Communication technique in which many different signal waveforms are transmitted in a wide band; power is spread thinly over the band so narrow band radios can operate within the wide band without interference; used to achieve security and privacy, prevent jamming, and utilize signals buried in noise.

MCGRAW HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, 4th ed. (1989).

Another technical dictionary provides the following definition:

> 1. A communications technique that involves transmitting information that has been multiplied by a pseudo-random noise (PN) sequence that essentially spreads it over a relatively wide frequency bandwidth. The receiver detects and uses the same PN sequence to "despread" the frequency bandwidth and decode the transmitted information. This communications technique allows greater signal density within a given transmission bandwidth and also provides a high degree of signal encryption and security in the process. 2. A communications technique in which many different signal waveforms are transmitted in a wide band. Power is spread thinly over the band so narrow band radios can operate within the wide band without interference.

Rudolf F. Graf, MODERN DICTIONARY OF ELECTRONICS, 7th ed. (1999).

The inventors have recognized that many of the benefits of spread spectrum communication (such as those mentioned in the above definitions, including robustness against noise, limited RF interference output over any given narrowband, and so forth) are also advantages in the medical diagnostic measurement field. The present application adapts the known concept of spread spectrum communication from the communications field to the diagnostic medical measurement field.

Referencing FIGURE 1 of the present application, a spread spectrum signal is created with the aid of random noise generated by the random signal generator (108) in communication with a signal transmitter (104) (page 5 lines 2-5). The spread spectrum signal in some described example embodiments has a range of 1-2 kHz, and in other described example embodiments has a range of 30-60 kHz, but in general is selected based on the measured parameter of interest (page 8 lines 1-3). The spread-spectrum signal interacts with the subject via the medium interface (102), examples of which include electrodes of an ECG or defibrillator (page 4 line 15), an ultrasound transducer (page 11 lines 15-16), a fingertip pulse oxymeter (p. 11 line 21-page 12 line 5), or so forth. A signal detector (106) and signal processor (116) detect parameters corresponding to the spread-spectrum signal transmitted into the body. The signal detector also receives the random noise from the random number generator (108) and the detected parameters are cross-correlated with the transmitted parameters (i.e., despread). See at least at page 8 lines 7-16.

The spread spectrum signal is spread thinly over a relatively wide bandwidth, so that it is unlikely to interfere with other medical equipment even if that other medical equipment operates over a narrow band within the broader bandwidth of the spread spectrum signal. Moreover, a narrowband signal from another piece of medical equipment is unlikely to interfere with the diagnostic equipment employing the spread spectrum signal, since the spread spectrum is unaffected except over the narrow band. Thus, medical diagnostic equipment employing spread spectrum signal transmission and detection including cross-correlation or despreading is robust against interference and is not itself a source of interference.

<u>The References of Record</u>

Kadin and **Abraham** disclose the concept of spread spectrum communication, which Applicants readily admit is known. Such communication systems are quite different from, and unrelated to, the medical measurement devices of the present application.

Eggleton, Fuller, and Feldman disclose diagnostic medical techniques, which however do not employ a spread spectrum signal that is detected and despread or cross-correlated to provide robustness against interference.

Eggleton discloses ultrasound imaging using random frequency noncoherent ultrasound transmission, rather than coherent ultrasound transmission, to eliminate interference fringes around the structure being imaged. These interference fringes are a coherency effect of the ultrasonic signal; they are not interference from other sources. Eggleton does not disclose or fairly suggest using spread spectrum transmission and reception. Rather, Eggleton merely suggests varying the frequency enough to destroy coherency based interference effects in the ultrasound images.

Fuller relates to RF spectroscopy of blood performed on a fingertip. Fuller discloses producing a broad spectrum by "a single oscillator [that] may be rapidly changed between discrete frequencies (e.g., in the manner of spread spectrum transmitters)." However, Fuller uses the generated broad spectrum for spectroscopic measurements, in which the broad spectrum signal is analyzed on a per frequency basis, looking for spectral chemical signatures. Thus, Fuller is not employing spread spectrum reception – there is no cross-correlating or despreading of the received signal respective to the transmitted signal. The spectroscopic approach of Fuller does not provide robustness against noise. For example, a narrowband noise source at or near the spectral location of a spectral chemical signature will greatly interfere with the accuracy of the Fuller RF spectrometer. Indeed, such a narrowband noise source has the potential to produce a false peak in the spectrum measured by Fuller, which might be erroneously interpreted as a spectral chemical signature.

Feldman is cited in the Office Action at page 12 as disclosing analyzing ultrasound echoes to determine a fetal heart rate. The Office Action does not suggest that Feldman employs spread spectrum signal and detection techniques.

The Claims Distinguish Patentably Over the Applied References

Each of the three independent claims set forth herein, namely claims 17, 20, and 28, is drawn to a spread spectrum measurement device or spread spectrum medical diagnostic measurement device or spread spectrum physiological condition measurement device operating on a patient or medical patient (these terms being intended to be broadly construed as encompassing, for example, a medical patient undergoing a routine physical checkup, a medical patient undergoing a health or employment medical screening, or so forth).

Claim 17 calls for a means for transmitting spread spectrum signals spread across a wide spectrum of frequencies (amendment supported at least at page 8 line 4) into a patient's body, means for detecting signals from the patient's body corresponding to the transmitted spread spectrum signals, means for generating a measured parameter from a cross-correlation of the transmitted and detected signals, and means for analyzing the measured parameter signal to measure a desired physiological condition.

The applied references, alone or in combination, do not disclose or fairly suggest claim 17. Kadin and Abraham relate to spread spectrum communication, but are unrelated to measuring devices. Eggleton and Feldman relate to measuring devices, but not to spread spectrum communication. Nothing in these references or their combination would motivate the skilled artisan to attempt to adapt spread spectrum communication to the very different measuring device application.

Fuller discloses a spectroscopic measurement using a broad spectrum source, which Fuller suggests may be generated "in the manner of spread spectrum transmitters". However, Fuller does not disclose or fairly suggest a means for generating a measured parameter from a cross-correlation of the transmitted and detected signals. Without the cross-correlation, the spectrometer of Fuller does not provide robustness against noise.

Claim 20 calls for a spread spectrum medical diagnostic measurement device including electrodes contacting a medical patient. A signal transmitter transmits a spread spectrum electrical input signal to the medical patient via at least some of the electrodes. The signal transmitter includes a random signal generator configured to generate a random signal used in generating the spread spectrum

electrical input signal. A signal detector is configured to detect a spread spectrum electrical signal using at least some of the electrodes and to despread the detected spread spectrum electrical signal to produce a measured parameter signal. A signal processor is configured to analyze the measured parameter signal to determine a physiological condition of the medical patient

None of the applied references disclose a medical diagnostic measurement device which employs a spread spectrum transmitter and a signal detector configured to detect a spread spectrum electrical signal using at least some of the electrodes contacting the medical patient and to despread the detected spread spectrum electrical signal. Kadin and Abraham are unrelated to medical diagnostic measurement, and for example do not employ electrodes contacting a medical patient. Eggleton and Feldman relate to ultrasound and hence do not employ electrodes contacting a medical patient, and moreover these references do not employ a spread spectrum signal. Fuller employs a broad spectrum source for spectroscopy, but does not despread a detected spread spectrum electrical signal.

Claim 28 calls for a spread spectrum physiological condition measurement device including a transmitter for conveying an input spread spectrum signal to a patient and a signal detector electrically connected to the patient to detect signals corresponding to the input spread spectrum signal. A random signal generator supplies a signal to the transmitter that is used by the transmitter to generate the input spread spectrum signal, and also supplies the signal to the signal detector where it is used to cross-correlate the detected signals corresponding to the input spread spectrum signal with the input spread spectrum signal to generate a measured parameter signal. A processor is programmed to analyze the measured parameter signal to measure a selected physiological condition.

None of the applied references disclose or fairly suggest a measurement device including a random signal generator that supplies a signal to both a transmitter and to a signal detector to enable cross-correlation at the signal detector of the detected signals corresponding to the input spread spectrum signal with the input spread spectrum signal to generate a measured parameter signal. Of the applied references, only Fuller discloses a measurement device including a random signal generator for generating a broad spectrum transmission. However, Fuller uses the

broad spectrum transmission signal for spectroscopic measurements, and accordingly does not additionally supply the signal of the random signal generator to a signal detector to enable cross-correlation. As a result, the Fuller spectrometer will not have robustness against noise compared with the cross-correlation-based detection approach called out in claim 28.

CONCLUSION

For the reasons set forth above, it is submitted that claims 2-5, 7-11, 17, 18, 20-22, 24, 27, and 28 as set forth herein (all claims) distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case(s), he is requested to telephone the undersigned at (216) 861-5582.

Respectfully submitted,

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